PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-086309
(43)Date of publication of application : 30.03.1999

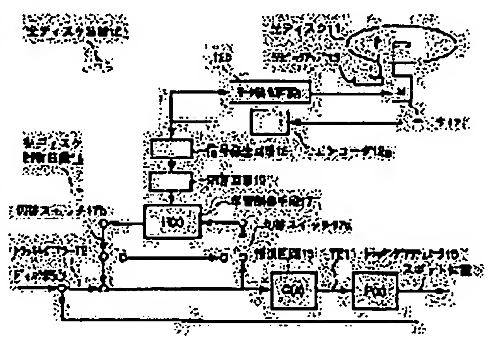
(51)Int.Cl. G11B 7/095
G11B 7/085

(21)Application number : 09-239500
(22)Date of filing : 04.09.1997

(71)Applicant : SONY CORP
(72)Inventor : ISHIBASHI JUNICHI

(54) OPTICAL DISK CONTROLLER

(57)Abstract:
PROBLEM TO BE SOLVED: To perform a correct tracking control or focusing control in the case of performing the reproducing of a new optical disk or track jump.
SOLUTION: This optical disk controller for an optical disk device 10 in which the signal recording surface of an optical disk 11 is irradiated with the light from an optical pickup 13 to detect the return light from the surface is provided with a tracking actuator 16 for adjusting the drive of the objective lens of the optical pickup 13 in the tracking direction of the optical disk 11, a control circuit 15 for adjusting the drive of the actuator 16 based on the tracking error signal generated based on the detection signal by the pickup 13 and a learning control means 17 by which the eccentricity of the disk 11 is learned to feedback the tracking error signal by the learning control based on the learning data, thereby performing learning controls based on learned data which are learned beforehand.



LEGAL STATUS
[Date of request for examination] 06.04.2004
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to tracking control and focal control about an optical disk unit and its control unit.
[0002]
[Description of the Prior Art] The optical disk unit conventionally equipped with such an optical disk control device is constituted as shown in drawing 9 or drawing 10 .
[0003] In drawing 9 , the optical disk unit 1 contains the motor 2 which carries out the rotation drive of the optical disk 2a, the optical pickup 3 which performs record or playback of a signal to optical disk 2a, and the optical disk control unit 4 which performs tracking control so that the objective lens of the optical pickup 3 may be made to follow the recording track of optical disk 2a.
[0004] Based on the detecting signal from encoder 2b which detects rotation of this motor 2, drive control of the above-mentioned motor 2 is carried out by motor control circuit 2c. Moreover, the above-mentioned optical pickup 3 is supported movable to optical disk 2a in 2 shaft orientations of tracking, i.e., the direction, and the direction of focusing.
[0005] And since the location of the disk horizontal direction of a recording track is not fixed when eccentricity is in optical disk 2a, the drive of the direction of tracking of the optical pickup 3 is controlled by the optical disk unit 1 with the optical disk control unit 4. The above-mentioned optical disk control device 4 contains tracking actuator 4b which carries out drive adjustment of the optical pickup 3 in the direction of tracking based on the tracking error signal TE 1 from compensating network 4a which carries out phase compensation of the tracking error signal TE based on the return light from optical disk 2a detected by the optical pickup 3 mentioned above, and compensating network 4a. Moreover, the optical disk control unit 4 is equipped with the digital memory 5 which performs the so-called learning control, for example, a shift register, by sampling the above-mentioned tracking error signal TE, and learning and feeding back a tracking error.
[0006] This shift register 5 has a fixed time delay, only one frequency or the frequency corresponding to that harmonic content is supported, and that output address is changed by address control circuit 5a based on the detecting signal from said encoder 2b which detects the rotational frequency of a motor 2. Thereby, in the so-called optical disk unit of CAV (method which rotates an optical disk by the constant angular velocity), the signal noise by the eccentricity of optical disk 2a is removed by the study effectiveness of the tracking error by the shift register 5.
[0007] For example, if the optical disk control unit 4 operates and starts control repeatedly as shown in drawing 11 (B) when there is a periodic tracking error signal TE by the eccentricity of an optical disk as shown in drawing 11 (A), after the amount of round term of the tracking error signal TE passes, a shift register 5 will learn the wave for this one period, and will add the signal which has the wave of opposition as shown in drawing 11 (C) as an output signal to the tracking error signal TE. Therefore, as the output signal of the above-mentioned optical disk control device 4 shows the tracking error signal TE to drawing 11 (D), the periodic change by the eccentricity of an optical disk will be removed.

Furthermore, also in the optical disk unit with which engine speeds, such as the so-called zone CAV (method which rotates an optical disk in a constant angular velocity) by which a disk engine speed is divided in the range of the radius which has optical disk 2a, for example, and the so-called CLV (method which rotates an optical disk in a constant linear velocity), differ, when the output address of a shift register 5 is changed by address control circuit 5a according to the engine speed of a motor 2, tracking control is performed correctly.
[0008] Moreover, in drawing 10 , the optical disk unit 6 contains the motor 2 which carries out the rotation drive of the optical disk 2a, the optical pickup 3 which performs record or playback of a signal to optical disk 2a, and the optical disk control unit 7 which performs focusing control of the optical pickup 3. That is, if face deflection is in the disk side of optical disk 2a, since the vertical location to the signal recording surface of the objective lens and disk of optical pickup will be changed, the drive of the direction of focusing of the optical pickup 3 is controlled by the optical disk unit 1 with the optical disk control unit 4.
[0009] Compensating network 7a which carries out phase compensation of the focal error signal FE based on the return light from optical disk 2a detected by the optical pickup 3 which mentioned above this optical disk control device 7, While focal actuator 7b which carries out drive adjustment of the optical pickup 3 in the direction of tracking based on focal error signal FE1 from compensating network 7a is included It has the digital memory 8 which performs the so-called learning control, for example, a shift register, by sampling the above-mentioned focal error signal FE furthermore, and learning and feeding back a focal error.
[0010] This shift register 8 has a fixed time delay, only one frequency or the frequency corresponding to that harmonic content is supported, and that output address is changed by address control circuit 8b based on the detecting signal from said encoder 2b which detects the rotational frequency of a motor 2. Thereby, like the case of the tracking control by the optical disk control device 4, according to the engine speed of a motor 2, the signal noise by the face deflection of optical disk 2a is removed, and focusing control is correctly performed according to the study effectiveness of a focal error also in the optical disk unit with which engine speeds differ.
[0011]
[Problem(s) to be Solved by the Invention] By the way, in the optical disk control devices 4 and 7 of such a configuration, shift registers 5 and 8 perform the sampling of the tracking error signal TE or focal error signal FE for every fixed time amount, and are performing study of a tracking error or a focal error. In order to realize optimal control, learning time was required for such study, and since positive learning control could not be performed until fixed learning time passed, at the time of playback initiation of an optical disk unit, there was a problem that tracking control or focal control will become unstable, especially.
[0012] Moreover, it records or reproduces from the truck which is begun point ** of No. 1 in tracking control, for example record of an optical disk, or in playback, and scans to the last truck as it is, it is new to perform record or playback, and record or playback of an optical disk is performed in many cases, coming and going between the trucks with which it differs on an optical disk in actual use, and performing the so-called track jump. In the case of such a track jump, point ** tracking control is turned OFF conventionally. Next, the optical pickup 3 is moved to a desired truck by inputting a jump command into tracking actuator 4b. Then, the study result in a shift register 5 is reset, it is detected, periodic eccentricity TE, i.e., tracking error, of optical disk 2a in a new truck, and study of a tracking error is performed based on this. Therefore, on the occasion of a track jump, since study needed to be redone from the start, there was a problem that the data transfer rate in record or playback of an optical disk will fall each time.
[0013] Furthermore, in the high density optical disk commercialized in recent years, since it was necessary to jump also in the direction of a focus and to redo study from the start also about the focusing control in this case each time in the case of the track jump covering the signal recording surface of two or more phases from having the signal recording surface of two or more phases in the optical disk of one sheet, there was a problem that a data transfer rate will fall similarly.

[0014] Furthermore, since it is dependent on the eccentricity of an optical disk, the optimum value of the initial value in tracking control is difficult for performing always optimal tracking control to the optical disk of all eccentricity at the time of record of an optical disk, or playback initiation. For example, when tracking control was performed to an optical disk with large eccentricity, there was a problem that record of an optical disk or the tracking control at the time of playback initiation will become unstable. Moreover, similarly, since it is dependent on the amount of face deflections of an optical disk, the optimum value of the initial value in focal control is difficult for performing always optimal focal control to the optical disk of all the amounts of field deflection at the time of record of an optical disk, or playback initiation. For example, when focal control was performed to an optical disk with the large amount of face deflections, there was a problem that record of an optical disk or the focal control at the time of playback initiation will become unstable.
[0015] The result of the simulation about such learning control is shown below. For example, drawing 12 is the case where fixed the time delay of the shift registers 5 and 8 of the optical disk control devices 4 and 7 which are learning-control systems, made the rotation period of an optical disk increase, and a gap of a rotation period increases several%. Drawing 13 is the case where decreased the rotation period of an optical disk and a gap of a rotation period decreases several%. Only by both shifting several%, the response to learning control will shift greatly.
[0016] Furthermore, when a steady state has study of the optical disk control units 4 and 7 and the amplitude of disturbance changes suddenly (i.e., when the eccentricity of an optical disk changes suddenly in a track jump etc.), the optical disk control unit 4 and the simulation result of a response of seven are shown below. That is, as tracking control shows drawing 14 (A) with the optical disk control device 4, when it is in a steady state and changes with 110%, 120%, and 130% as the eccentricity of the optical disk which is disturbance shows drawing 14 (B) for example, the effect by change of this disturbance will occur in a round term until tracking control by learning control is performed. Moreover, as tracking control shows drawing 15 (A) with the optical disk control device 4, when it is in a steady state and changes with 90%, 80%, and 70% as the eccentricity of the optical disk which is disturbance shows drawing 14 (B) for example, the effect by change of this disturbance will occur in a round term until tracking control by learning control is performed.
[0017] This invention aims at offering the optical disk unit and the control unit used for this with which exact tracking control or focal control was made to be performed also on the occasion of a track jump, when performing record or playback of a new optical disk in view of the above point.
[0018]
[Means for Solving the Problem] As opposed to the signal recording surface of the optical disk with which the rotation drive of the above-mentioned technical problem is carried out according to this invention Irradiate light from optical pickup and optical pickup detects the return light. The tracking actuator which is the control device of the optical disk unit which performs the record and/or playback of a signal to an optical disk, and carries out drive adjustment of the objective lens of said optical pickup about the direction of tracking of an optical disk, The control circuit which controls this tracking actuator based on the tracking error signal generated based on the detecting signal by said optical pickup, Learn the eccentricity of said optical disk and by the learning control based on this study data The learning-control means to which feedback is applied is included in said tracking error signal, and said learning-control means is attained by the optical disk control unit which performs learning control based on the study data learned beforehand at the time of control initiation.
[0019] Moreover, according to this invention, the above-mentioned technical problem receives the signal recording surface of the optical disk by which a rotation drive is carried out. Irradiate light from optical pickup and optical pickup detects the return light. The focal actuator which is the control device of the optical disk unit which performs the record and/or playback of a signal to an optical disk, and carries out drive adjustment of the objective lens of said optical pickup about the direction of a focus of an optical disk, The control circuit which controls this focal actuator based on the focal error signal generated based on the detecting signal by said optical pickup, Learn the face deflection of said optical disk and by the learning control based on this study data The learning-control means to which feedback

is applied is included in said focal error signal, and said learning-control means is attained by the optical disk control unit which performs learning control based on the study data learned beforehand at the time of control initiation.
[0020] In case according to the above-mentioned configuration drive adjustment of the objective lens of optical pickup is carried out in the direction of tracking, or the direction of a focus with an actuator and tracking control or focal control is performed for example, at the time of the control initiation in the power up of an optical disk unit, the time of optical disk insertion or the reuse of the same optical disk, etc. For example, when an above-mentioned learning-control means by which at least digital memory and a straight line consist of either at least among phase digital filters performs learning control based on the study data learned beforehand, tracking control or focal control is performed. Therefore, since learning control is performed using the study data learned beforehand at the time of control initiation, without being based on the study data which a learning-control means acquires after control initiation, learning control will be suitably performed also for between learning time required for acquisition of study data. Thereby, the system deviation of the tracking control at the time of control initiation or focal control is reduced.
[0021] The above-mentioned learning-control means in the case of a track jump In holding study data and performing learning control after track jump termination based on the study data concerned Since similarly the study data between track jumps and in front of a track jump are held and learning control is performed after track jump termination based on this study data currently held At every track jump, study data will be reset and learning control will be suitably performed as compared with the case where study is newly started. Thereby, the system deviation of the tracking control at the time of a track jump or focal control is reduced.
[0022] When the above-mentioned learning-control means drives based on the clock signal generated by the signal generating circuit corresponding to rotation of an optical disk, even if the clock signal which drives the above-mentioned learning-control means is the optical disk of what kind of numbers of rotations, such as CAV and CLV, by being generated corresponding to rotation of an optical disk, study of a tracking error or a focal error is attained, and the system deviation of tracking control or focal control is reduced.
[0023] When the above-mentioned signal generating circuit is the encoder formed in the rotation driving means of an optical disk, a clock signal is generated by the encoder from the signal generated for every fixed angle of rotation of an optical disk.
[0024] Since the wobbling signal in the groove section of an optical disk is a signal generated for every fixed angle of rotation of an optical disk when the above-mentioned optical disk generates a clock signal based on the wobbling signal with which it is the optical disk which has the groove section by which wobbling was carried out with predetermined frequency, and the above-mentioned signal generating circuit was taken out from the detecting signal by optical pickup, a clock signal is generated by this wobbling signal. In this case, a wobbling signal is taken out through a band pass filter etc. to the tracking error signal taken out from the detecting signal of optical pickup for example.
[0025] The above-mentioned optical disk is an optical disk which has the land for recording a signal and/or the groove section, and the pit address part for recording address information, and when generating a clock signal based on the address information by which the above-mentioned signal generating circuit was taken out from the detecting signal by optical pickup, the signal for every fixed angle of rotation of an optical disk is taken out from the pit address signal from this pit address part itself.
[0026] When it has the arithmetic circuit which the number of clocks per one revolution is changed, and inputs the clock signal from the above-mentioned signal generating circuit into a learning-control means corresponding to the rotational frequency of an optical disk, the number of clocks of a clock signal changes with these arithmetic circuits according to the rotational frequency of an optical disk. When the rotational frequency of an optical disk becomes low by this, the fall of time resolution is prevented by increasing the number of clocks by the above-mentioned arithmetic circuit, and even if it is the case that a rotational frequency is low, exact tracking control or focal control is performed. In this case, as for the

above-mentioned arithmetic circuit, for example, a PLL (phase-locked loop) circuit is used.
[0027]
[Embodiment of the Invention] Hereafter, the suitable operation gestalt of this invention is explained to a detail, referring to drawing 1 thru/or drawing 8 . In addition, since the operation gestalt described below is the suitable example of this invention, desirable various limitation is attached technically, but especially the range of this invention is not restricted to these modes, as long as there is no publication of the purport which limits this invention in the following explanation.
[0028] Drawing 1 and drawing 2 show the first operation ****** of the optical disk control unit by this invention. In drawing 1 , the optical disk unit 10 contains the motor 12 which carries out the rotation drive of the optical disk 11, the optical pickup 13 which performs record or playback of a signal to an optical disk 11, and the optical disk control unit 14 which performs tracking control of the optical pickup 13.
[0029] Based on the detecting signal from encoder 12a which detects rotation of this motor 12, drive control is carried out by motor control circuit 12b, and the rotation drive of the above-mentioned motor 12 is carried out at a predetermined rotational frequency. Moreover, the above-mentioned optical pickup 13 is supported movable to the optical disk 11 in 2 shaft orientations of tracking, i.e., the direction, and the direction of focusing, irradiates light at the signal recording surface of an optical disk 11, and detects the return light.
[0030] The above-mentioned optical disk control device 14 contains the tracking actuator 16 which carries out drive adjustment of the objective lens 13a of the optical pickup 13 in the direction of tracking based on the tracking error signal TE 1 from the dynamic characteristics compensating network 15 which carries out phase compensation of the tracking error signal TE based on the return light from the optical disk 11 detected by the optical pickup 13 mentioned above, and a compensating network 15. Moreover, the optical disk control unit 14 is equipped with a learning-control means 17 to perform learning control of the tracking error signal TE, by sampling the above-mentioned tracking error signal TE further, and learning and feeding back a tracking error.
[0031] Here, it operates with the clock signal with which the learning-control means 17 is constituted so that the amplitude characteristic of a phase digital filter may turn into a low pass filter property at least in the straight line while at least a digital filter or a straight line gives a time delay to the tracking error signal TE by [of a phase digital filter] consisting of either at least and feeding back the tracking error signal TE, and it was generated by the signal generating circuit 18 based on the detecting signal from encoder 12a. Moreover, the above-mentioned learning-control means 17 study-data at the time of tracking control initiation are memorized beforehand.
[0032] The above-mentioned learning-control means 17 equips the input side and output side with circuit changing switches 17a and 17b, and it feeds back the output signal to the tracking error signal TE in the first change location (refer to drawing 1) of each circuit changing switches 17a and 17b while the tracking error signal TE is inputted into the learning-control means 17 through circuit changing switch 17a. On the other hand, in the second change location (refer to drawing 2) of each circuit changing switches 17a and 17b, the output signal returns to the learning-control means 17, and it is inputted into it. Here, the above-mentioned changeover switches 17a and 17b are made into the change location of the off above second, and nothing is inputted into the learning-control means 17, but it considers as the condition that nothing is outputted at a power up. next, the electromagnetism of the optical pickup 13 -- the driver voltage of a sine wave is given to the focal actuator which becomes by the driving means, and optical pickup is driven in the direction of a focus. And the output of the photodetector with which the optical pickup 13 was equipped is seen, and if the focal error signal which reaches the conditions defined beforehand is outputted, the control system of only the conventional linear control system will begin to drive. And if the response of a focal control system will be in a steady state, since it will become detectable [a tracking error signal], the tracking control system of drawing 1 is driven. If the response of a tracking control system will be in a steady state, the above-mentioned switches 17a and 17b will be changed in the first place, it will connect as a location, and study of the learning-control means 17 will be started. The digital operation of the data which this sampled and obtained with the

clock signal generated by the above-mentioned signal generating circuit 18 based on the tracking error signal is carried out with the learning-control means 17, and this is carried out to the time amount which hits a part for a term several rounds of disk rotation in between. Since study is completed by this, let the above-mentioned changeover switches 17a and 17b be the second change location. Thereby, study data are held by making changeover switches 17a and 17b into the second change location. In addition, maintenance of study data may extend memory not only an above-mentioned means but required, for example, or you may make it use the existing memory.
[0033] The optical disk control unit 14 by this operation gestalt is constituted as mentioned above, and the learning-control means 17 mentioned above has each circuit changing switches 17a and 17b in the first location, and usually always serves as a fixed time delay per one revolution from driving with the clock signal generated by the signal generating circuit 18 based on the detecting signal from encoder 12a about the rotational frequency of an optical disk 11. Therefore, in the optical disk unit of any engine speeds, whether the time delay of the learning-control means 17 and the rotation period of an optical disk 11 will be correctly in agreement, and are the optical disk unit of CLV or zone CAV or it is the case where there is rotation nonuniformity in the optical disk unit of CAV, more exact tracking control is performed and the system deviation of tracking control is reduced.
[0034] Here, when the power source of an optical disk unit 10 was switched on, or when an optical disk unit 10 is loaded with an optical disk 11, in the case of the same reuse of an optical disk 11, the learning-control means 17 carries out study about the disk eccentricity about the optical disk 11 concerned immediately. And the learning-control means 17 feeds back to the tracking error signal TE with initiation of tracking control based on the study data learned beforehand. Since learning control is suitably performed also for between time amount required for study by this properly speaking, tracking control with more little system deviation will be performed.
[0035] Moreover, by changing to the second change location which shows each circuit changing switches 17a and 17b of the learning-control means 17 to drawing 2 , when performing a track jump by record or playback of an optical disk 11, the output signal will return and the learning-control means 17 will be inputted. Thereby, the learning-control means 17 holds the study data learned about the truck in front of a track jump after the phase which is high sensitivity had locked to the error. And after track jump termination, while the learning-control means 17 starts study about a new truck, based on the study data currently held as mentioned above, it performs learning control by new truck, namely, feeds back an output signal to the tracking error signal TE. Thereby, good tracking control with little system deviation is immediately performed also after a track jump.
[0036] Moreover, since a high frequency component will be removed from the tracking error signal TE when the phase digital filter has the low pass filter property at least for the straight line of the above-mentioned learning-control means 17, while stable tracking control is performed, mixing of non-periodicity signals, such as a noise, is reduced.
[0037] Here, in drawing 1 , the optical disk control unit 14 mentioned above may be equipped with the arithmetic circuit 19 to which the number of clocks of the clock signal from a signal generating circuit 18 is changed, as the chain line shows. In this case, by using for example, a PLL circuit, according to the rotational frequency of an optical disk 11, an arithmetic circuit 19 fluctuates the number of clocks, and raises time resolution. By this, when the engine speed of an optical disk 11 changes in optical disk units, such as CLV, even if it is at the time when the engine speed of an optical disk 11 is low, tracking control with a high precision will be performed so that the sampling period by the learning-control means 17 may not fall.
[0038] Drawing 3 and drawing 4 show the second operation gestalt of the optical disk control unit by this invention. In drawing 3 , the optical disk unit 20 contains the motor 12 which carries out the rotation drive of the optical disk 11, the optical pickup 13 which performs record or playback of a signal to an optical disk 11, and the optical disk control unit 21 which performs focal control of the optical pickup 13.
[0039] The above-mentioned motor 12 and the optical pickup 13 are the same configurations as the motor 12 in the optical disk unit 10 shown in drawing 1 , and the optical pickup 13.

[0040] The dynamic characteristics compensating network 22 which carries out phase compensation of the focal error signal FE based on the return light from the optical disk 11 detected by the optical pickup 13 which mentioned above the above-mentioned optical disk control device 21, While the focal actuator 23 which carries out drive adjustment of the optical pickup 13 in the direction of a focus based on focal error signal FE1 from a compensating network 22 is included It has a learning-control means 24 to perform learning control of focal error signal FE, by sampling the above-mentioned focal error signal FE furthermore, and learning and feeding back a focal error.
[0041] Here, it operates with the clock signal with which the learning-control means 24 is constituted so that the amplitude characteristic of a phase digital filter may turn into a low pass filter property at least in the straight line while at least a digital filter or a straight line gives a time delay to focal error signal FE by [of a phase digital filter] consisting of either at least and feeding back focal error signal FE, and it was generated by the signal generating circuit 25 based on the detecting signal from encoder 12a. The above-mentioned learning-control means 24 equips the input side and output side with circuit changing switches 24a and 24b, and it feeds back the output signal to focal error signal FE in the first change location (refer to drawing 1) of each circuit changing switches 24a and 24b while focal error signal FE is inputted into the learning-control means 24 through circuit changing switch 24a. On the other hand, in the second change location (refer to drawing 3) of each circuit changing switches 24a and 24b, the output signal returns to the learning-control means 24, and it is inputted into it.
[0042] Here, the above-mentioned changeover switches 24a and 24b are made into the change location of the off above second, and nothing is inputted into the learning-control means 24, but it considers as the condition that nothing is outputted at a power up. next, the electromagnetism of the optical pickup 13 -- the driver voltage of a sine wave is given to the focal actuator which becomes by the driving means, and optical pickup is driven in the direction of a focus. And the output of the photodetector with which the optical pickup 13 was equipped is seen, and if the focal error signal which reaches the conditions defined beforehand is outputted, the control system of only the conventional linear control system will begin to drive. And if the response of a focal control system will be in a steady state, the above-mentioned switches 24a and 24b will be connected as first change location, and study of the learning-control means 24 will be started. The digital operation of the data which this sampled and obtained with the clock signal generated by the above-mentioned signal generating circuit 26 is carried out with the learning-control means 24, and this is carried out to the time amount which hits a part for a term several rounds of disk rotation in between. Since study is completed by this, let the above-mentioned changeover switches 24a and 24b be the second change location. Thereby, study data are held by making changeover switches 24a and 24b into the second change location. In addition, maintenance of study data may extend memory not only an above-mentioned means but required, for example, or you may make it use the existing memory.
[0043] The optical disk control unit 21 by this operation gestalt is constituted as mentioned above, and the learning-control means 24 mentioned above usually has each circuit changing switches 24a and 24b in the first location, and it always serves as a fixed time delay per one revolution from driving with the clock signal generated by the signal generating circuit 25 based on the detecting signal from encoder 12a about the rotational frequency of an optical disk 11. Therefore, in the optical disk unit of any engine speeds, whether the time delay of the learning-control means 24 and the rotation period of an optical disk 11 will be correctly in agreement, and are the optical disk unit of CLV or zone CAV or it is the case where there is rotation nonuniformity in the optical disk unit of CAV, more exact focal control is performed and the system deviation of focal control is reduced.
[0044] Here, when the power source of an optical disk unit 10 was switched on, or when an optical disk unit 10 is loaded with an optical disk 11, in the case of the same reuse of an optical disk 11, the learning-control means 24 carries out study about the face deflection about the optical disk 11 concerned immediately. And the learning-control means 17 feeds back to focal error signal FE with initiation of focal control based on the study data learned beforehand. Since learning control is suitably performed also for between time amount required for study by this properly speaking, focal control with more little system deviation will be performed.

[0045] Moreover, when performing a track jump by record or playback of an optical disk 11, as for the learning-control means 17, the output signal will be inputted by changing to the second change location which shows each circuit changing switches 17a and 17b of the learning-control means 17 to drawing 2 . Thereby, the learning-control means 17 holds the study data learned about the truck in front of a track jump after the phase which is high sensitivity had locked to the error. And after track jump termination, while the learning-control means 17 starts study about a new truck, based on the study data currently held as mentioned above, it performs learning control by new truck, namely, feeds back an output signal to focal error signal FE. Thereby, little good focal control of system deviation is immediately performed also after a track jump.
[0046] Moreover, since a high frequency component will be removed from focal error signal FE when the phase digital filter has the low pass filter property at least for the straight line of the above-mentioned learning-control means 24, while stable focal control is performed, mixing of non-periodicity signals, such as a noise, is reduced.
[0047] Here, in drawing 3 , the optical disk control unit 21 mentioned above may be equipped with the arithmetic circuit 26 to which the number of clocks of the clock signal from a signal generating circuit 25 is changed, as the chain line shows. In this case, by using for example, a PLL circuit, according to the rotational frequency of an optical disk 11, an arithmetic circuit 26 fluctuates the number of clocks, and raises time resolution. By this, even if it is the case that the rotational frequency of an optical disk 11 is low, focal control with a high precision will be performed so that the sampling period by the learning-control means 24 may not fall.
[0048] Drawing 5 and drawing 6 show the third operation gestalt of the optical disk control unit by this invention. In drawing 5 , an optical disk unit 30 is an optical disk unit for the optical disk which has the land for recording a signal and/or the groove section, and the pit address part for recording address information, for example, a compact disk etc., (CD), and contains the motor 32 which carries out the rotation drive of the optical disk 31, the optical pickup 33 which performs record or playback of a signal to an optical disk 31, and the optical disk control unit 34 which performs tracking control of the optical pickup 33.
[0049] Drive control is carried out by motor control circuit 32a, and the rotation drive of the above-mentioned motor 32 is carried out at a predetermined rotational frequency. In this case, although a motor 32 is not equipped with the encoder for rotation detection, the rotational frequency of a motor 32 is detected based on the Horizontal Synchronizing signal included in the frame sink signal included in the playback digital signal of an optical disk, or a playback video signal. Moreover, the above-mentioned optical pickup 33 is supported movable to the optical disk 31 in 2 shaft orientations of tracking, i.e., the direction, and the direction of focusing, irradiates light at the signal recording surface of an optical disk 31, and detects the return light.
[0050] The above-mentioned optical disk control device 34 sampled the above-mentioned tracking error signal TE further, and is equipped with a learning-control means 37 learn and feed back a tracking error while it contains the tracking actuator 36 which carries out drive adjustment of the objective lens 33a of the optical pickup 33 in the direction of tracking based on the tracking error signal TE 1 from the dynamic-characteristics compensating network 35 which carries out phase compensation of the tracking error signal TE based on the return light from the optical disk 31 detected by the optical pickup 33 mentioned above, and a compensating network 35.
[0051] Here, it operates with the clock signal with which the learning-control means 37 is constituted so that the amplitude characteristic of a phase digital filter may turn into a low pass filter property at least in the straight line while at least a digital filter or a straight line gives a time delay to the tracking error signal TE by [of a phase digital filter] consisting of either at least and feeding back the tracking error signal TE, and it was generated by the signal generating circuit 38. The above-mentioned signal generating circuit 38 generates a clock signal based on the address information contained in the regenerative signal by inputting a regenerative signal based on the detecting signal of the optical pickup 33 from the regenerative-signal processing circuit 39 which generates a regenerative signal and an error signal. In this case, a signal generating circuit 38 sets up a clock frequency corresponding to the radius

location of the optical disk 31 by address information. Moreover, the above-mentioned learning-control means 37 study-data at the time of tracking control initiation are memorized beforehand.
[0052] Furthermore, the above-mentioned learning-control means 37 equips the input side and output side with circuit changing switches 37a and 37b, and it feeds back the output signal to the tracking error signal TE in the first change location (refer to drawing 5) of each circuit changing switches 37a and 37b while the tracking error signal TE is inputted into the learning-control means 37 through circuit changing switch 37a. On the other hand, the output signal is inputted into the learning-control means 37 in the second change location (refer to drawing 6) of each circuit changing switches 37a and 37b. The acquisition and maintenance of study data by this learning-control means 37 are the same as that of the case of drawing 1 and drawing 2 almost.
[0053] The optical disk control unit 34 by this operation gestalt is constituted as mentioned above, and the learning-control means 37 mentioned above usually has each circuit changing switches 37a and 37b in the first location, and it drives with the clock signal generated by the signal generating circuit 38 based on the regenerative signal from the regenerative-signal processing circuit 39. Since the clock signal of the frequency corresponding to the radius location of an optical disk 31 is generated based on the address information by which a signal generating circuit 38 is contained in a regenerative signal at this time, it is possible for the learning-control means 37 to always make that time delay in agreement with the rotation period of an optical disk 31 based on this clock signal.
[0054] Therefore, in the optical disk unit of any engine speeds, whether the time delay of the learning-control means 37 and the rotation period of an optical disk 31 will be correctly in agreement, and are the optical disk unit of CLV or zone CAV or it is the case where there is rotation nonuniformity in the optical disk unit of CAV, more exact tracking control is performed and the system deviation of tracking control is reduced.
[0055] Here, when the power source of an optical disk unit 30 was switched on, or when an optical disk unit 30 is loaded with an optical disk 31, in the case of the same reuse of an optical disk 31, the learning-control means 37 carries out study about the disk eccentricity about the optical disk 31 concerned immediately. And the learning-control means 37 feeds back to the tracking error signal TE with initiation of tracking control based on the study data learned beforehand. Since learning control is suitably performed also for between time amount required for study by this properly speaking, tracking control with more little system deviation will be performed.
[0056] Moreover, when performing a track jump by record or playback of an optical disk 31, as for the learning-control means 37, the output signal will be inputted by changing to the second change location which shows each circuit changing switches 37a and 37b of the learning-control means 37 to drawing 6 . Thereby, the learning-control means 37 holds the study data learned about the truck in front of a track jump after the phase which is high sensitivity had locked to the error. And after track jump termination, while the learning-control means 37 starts study about a new truck, based on the study data currently held as mentioned above, it performs learning control by new truck, namely, feeds back an output signal to the tracking error signal TE. Thereby, good tracking control with little system deviation is immediately performed also after a track jump.
[0057] Moreover, since a high frequency component will be removed from the tracking error signal TE when the phase digital filter has the low pass filter property at least for the straight line of the above-mentioned learning-control means 37, while stable tracking control is performed, mixing of non-periodicity signals, such as a noise, is reduced.
[0058] Even if it is the case where there is no encoder for detecting rotation of the motor 32 which carries out the rotation drive of the optical disk 31 in this way, tracking control will be performed with high degree of accuracy.
[0059] Although signal generation equipment 38 generates a clock signal in the above-mentioned optical disk control unit 30 here based on the address information contained in the regenerative signal by the optical pickup 33, when an optical disk 31 is a magneto-optic disk, signal generation equipment 38 obtains the address information of an optical disk 31 from the tracking error signal TE by the optical pickup 33 by taking out a wobbling signal with a band pass filter, and carrying out FM recovery of this

signal. And signal generation equipment 38 generates a clock signal based on this address information. In this way, signal generation equipment 38 can generate the clock signal according to the rotational frequency, also when an optical disk 31 is a magneto-optic disk.

[0060] Drawing 7 and drawing 8 show the fourth operation gestalt of the optical disk control unit by this invention. In drawing 7 , an optical disk unit 40 is an optical disk unit for the optical disk which has the land for recording a signal and/or the groove section, and the pit address part for recording address information, for example, a compact disk etc., (CD), and contains the motor 32 which carries out the rotation drive of the optical disk 31, the optical pickup 33 which performs record or playback of a signal to an optical disk 31, and the optical disk control unit 41 which performs focal control of the optical pickup 33.

[0061] The above-mentioned motor 32 and the optical pickup 33 are the same configurations as the motor 32 in the optical disk unit 30 shown in drawing 3 , and the optical pickup 33.

[0062] The dynamic characteristics compensating network 42 which carries out phase compensation of the focal error signal FE based on the return light from the optical disk 31 detected by the optical pickup 33 which mentioned above the above-mentioned optical disk control device 41, While the focal actuator 36 which carries out drive adjustment of the objective lens 33a of the optical pickup 33 in the direction of a focus is included based on focal error signal FE1 from a compensating network 42 It has a learning-control means 44 to perform learning control of focal error signal FE, by sampling the above-mentioned focal error signal FE furthermore, and learning and feeding back a focal error.

[0063] Here, it operates with the clock signal with which the learning-control means 44 is constituted so that the amplitude characteristic of a phase digital filter may turn into a low pass filter property at least in the straight line while at least a digital filter or a straight line gives a time delay to focal error signal FE by [of a phase digital filter] consisting of either at least and feeding back focal error signal FE, and it was generated by the signal generating circuit 45. The above-mentioned signal generating circuit 45 generates a clock signal based on the address information contained in the regenerative signal by inputting a regenerative signal based on the detecting signal of the optical pickup 33 from the regenerative-signal processing circuit 39 which generates a regenerative signal and an error signal. In this case, a signal generating circuit 45 sets up a clock frequency corresponding to the radius location of the optical disk 31 by address information. Moreover, the above-mentioned learning-control means 44 study-data at the time of focal control initiation are memorized beforehand.

[0064] Furthermore, the above-mentioned learning-control means 44 equips the input side and output side with circuit changing switches 44a and 44b, and it feeds back the output signal to focal error signal FE in the first change location (refer to drawing 7) of each circuit changing switches 44a and 44b while focal error signal FE is inputted into the learning-control means 44 through circuit changing switch 44a. On the other hand, the output signal is inputted into the learning-control means 44 in the second change location (refer to drawing 8) of each circuit changing switches 44a and 44b. The acquisition and maintenance of study data by this learning-control means 44 are the same as that of the case of drawing 3 and drawing 4 almost.

[0065] The optical disk control unit 41 by this operation gestalt is constituted as mentioned above, and the learning-control means 44 mentioned above has each circuit changing switches 44a and 44b in the first location, and usually drives it with the clock signal generated by the signal generating circuit 45 based on the regenerative signal from the regenerative-signal processing circuit 39. Since the clock signal of the frequency corresponding to the radius location of an optical disk 31 is generated based on the address information by which a signal generating circuit 45 is contained in a regenerative signal at this time, it is possible for the learning-control means 44 to always make that time delay in agreement with the rotation period of an optical disk 31 based on this clock signal. Therefore, in the optical disk unit of any engine speeds, whether the time delay of the learning-control means 44 and the rotation period of an optical disk 31 will be correctly in agreement, and are the optical disk unit of CLV or zone CAV or it is the case where there is rotation nonuniformity in the optical disk unit of CAV, more exact focal control is performed and the system deviation of focal control is reduced. Moreover, since a high frequency component will be removed from focal error signal FE when the phase digital filter has the

low pass filter property at least for the straight line of the above-mentioned learning-control means 44, while stable focal control is performed, mixing of non-periodicity signals, such as a noise, is reduced. Even if it is the case where there is no encoder for detecting rotation of the motor 32 which carries out the rotation drive of the optical disk 31 in this way, focal control will be performed with high degree of accuracy.

[0066] Although signal generation equipment 45 generates a clock signal in the above-mentioned optical disk control unit 40 here based on the address information contained in the regenerative signal by the optical pickup 33, when an optical disk 31 is a magneto-optic disk, signal generation equipment 45 obtains the address information of an optical disk 31 from the tracking error signal TE by the optical pickup 33 by taking out a wobbling signal with a band pass filter, and carrying out FM recovery of this signal. And signal generation equipment 38 generates a clock signal based on this address information. In this way, signal generation equipment 38 can generate the clock signal according to the rotational frequency, also when an optical disk 31 is a magneto-optic disk.

[0067] Here, in order to detect the rotational frequency of an optical disk 11 12, i.e., a motor, in the optical disk control devices 14 and 21 shown in drawing 1 and drawing 3 , encoder 12a is prepared, but if the rotational frequency of not only this but the motor 12 is detected, it is clear that the rotation detection means of other configurations is used.

[0068] Moreover, the optical disk control devices 34 and 41 shown in drawing 3 and drawing 4 may be equipped with the arithmetic circuit (not shown) to which the number of clocks of the clock signal from signal generating circuits 38 and 45 is changed like drawing 1 and the optical disk control devices 14 and 21 of drawing 2 , respectively. In this case, by using for example, a PLL circuit, according to the rotational frequency of an optical disk 31, this arithmetic circuit fluctuates the number of clocks, and raises time resolution. By this, when the engine speed of an optical disk 31 changes in optical disk units, such as CLV, even if it is at the time when the engine speed of an optical disk 31 is low, tracking control with a high precision and focal control will be performed so that the sampling period by the learning-control means 37 and 44 may not fall.

[0069]

[Effect of the Invention] As stated above, when performing record or playback of a new optical disk according to this invention, the optical disk control unit with which quick and exact tracking control or focal control was made to be performed also on the occasion of a track jump can be offered.

[Translation done.]

DESCRIPTION OF DRAWINGS

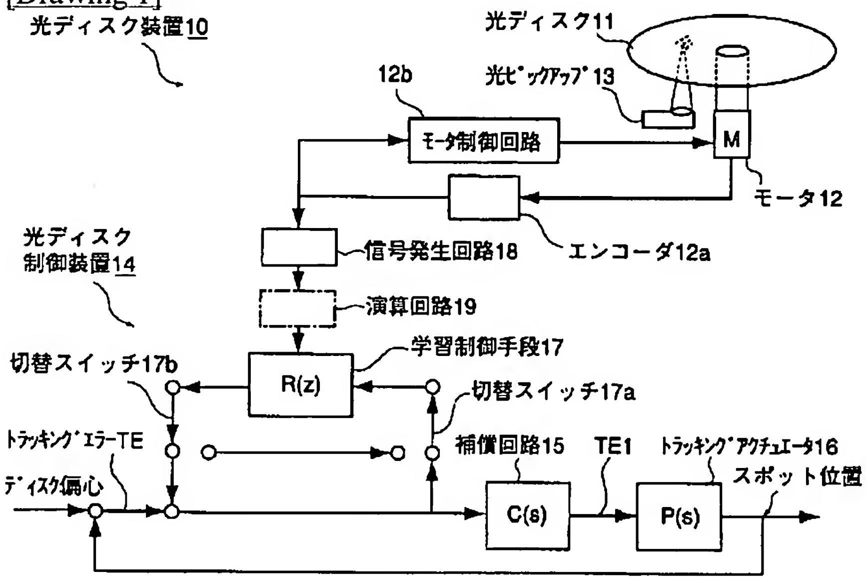
[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram showing the first operation gestalt of the optical disk control device by this invention.
[Drawing 2] It is the outline block diagram showing the condition at the time of the track jump in the optical disk control device of drawing 1 .
[Drawing 3] It is the outline block diagram showing the second operation gestalt of the optical disk control device by this invention.
[Drawing 4] It is the outline block diagram showing the condition at the time of the track jump in the optical disk control device of drawing 3 .
[Drawing 5] It is the outline block diagram showing the third operation gestalt of the optical disk control device by this invention.
[Drawing 6] It is the outline block diagram showing the condition at the time of the track jump in the optical disk control device of drawing 5 .
[Drawing 7] It is the outline block diagram showing the fourth operation gestalt of the optical disk control device by this invention.
[Drawing 8] It is the outline block diagram showing the condition at the time of the track jump in the optical disk control device of drawing 7 .
[Drawing 9] It is the outline block diagram showing an example of the conventional optical disk control device.
[Drawing 10] It is the outline block diagram showing other examples of the conventional optical disk control device.
[Drawing 11] It is the graph which shows (A) disturbance wave in the repetition control by the conventional optical disk control unit, (B) control turning on and off, (C) control wave, and the wave after control of (D) disturbance wave, respectively.
[Drawing 12] It is the graph which shows change of a response when the disturbance frequency in the repetition control by the conventional optical disk control unit increases.
[Drawing 13] It is the graph which shows change of a response when the disturbance frequency in the repetition control by the conventional optical disk control unit decreases.
[Drawing 14] It is the graph which shows change and (B) disturbance wave of the (A) response when the disturbance amplitude in the steady state of the study in the repetition control by the conventional optical disk control unit increases.
[Drawing 15] It is the graph which shows change and (B) disturbance wave of the (A) response when the disturbance amplitude in the steady state of the study in the repetition control by the conventional optical disk control unit decreases.
[Description of Notations]
10, 20, 30, 40 ... 11 An optical disk unit, 31 ... Optical disk, 12 32 ... 13 A motor, 33 ... Optical pickup, 14, 21, 34, 41 ... Optical disk control unit, 15, 22, 35, 42 ... 16 A compensating circuit, 36 ... Tracking actuator, 23 43 ... A focal actuator, 17, 24, 37, 44 ... Learning-control means, 17a, 17b, 24a, 24b, 37a,

37b, 44a, 44b [... Regenerative-signal processing circuit.] ... A circuit changing switch, 18, 25, 38, 45 ... 19 A signal generating circuit, 26 ... An arithmetic circuit, 39

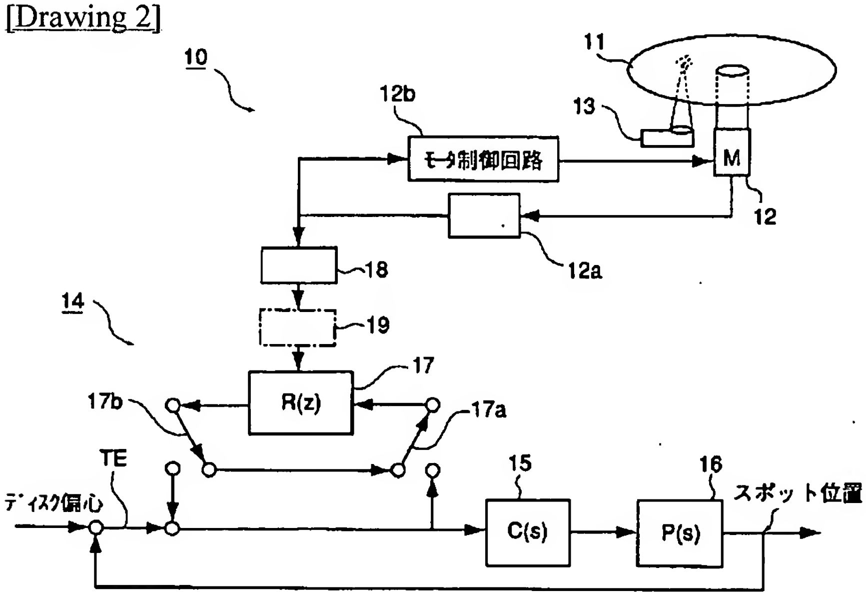
[Translation done.]

DRAWINGS

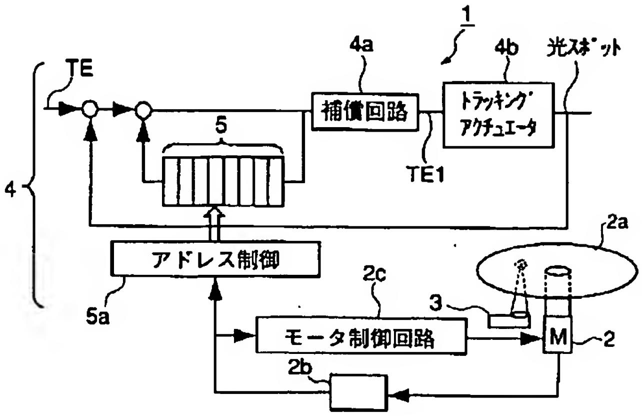
[Drawing 1]



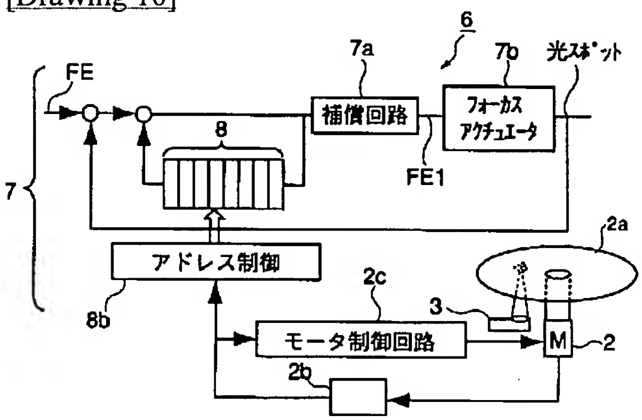
[Drawing 2]



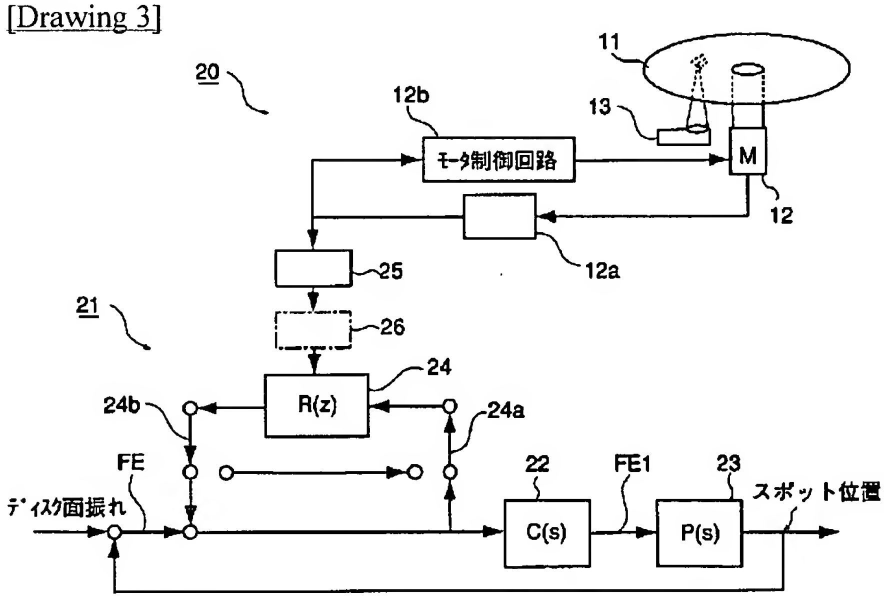
[Drawing 9]



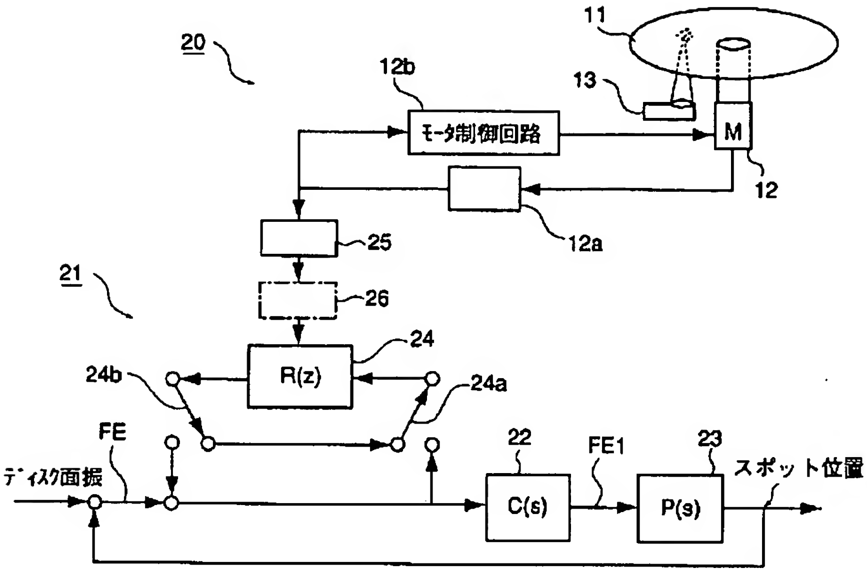
[Drawing 10]



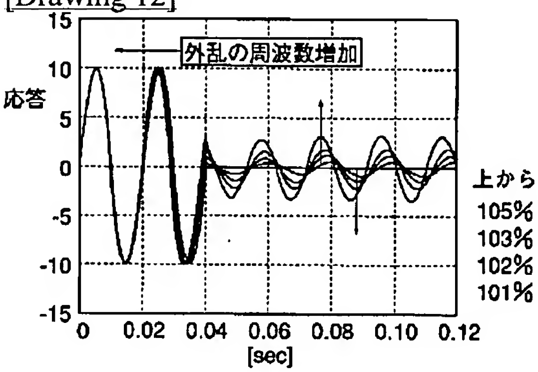
[Drawing 3]



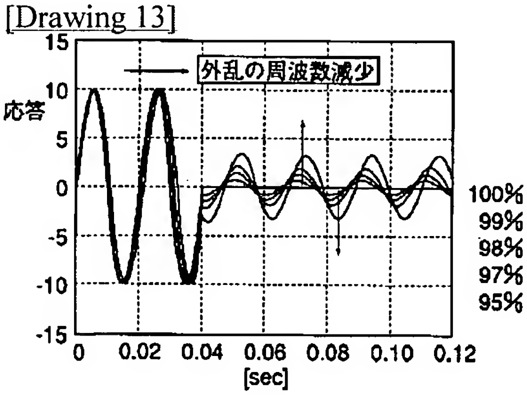
[Drawing 4]



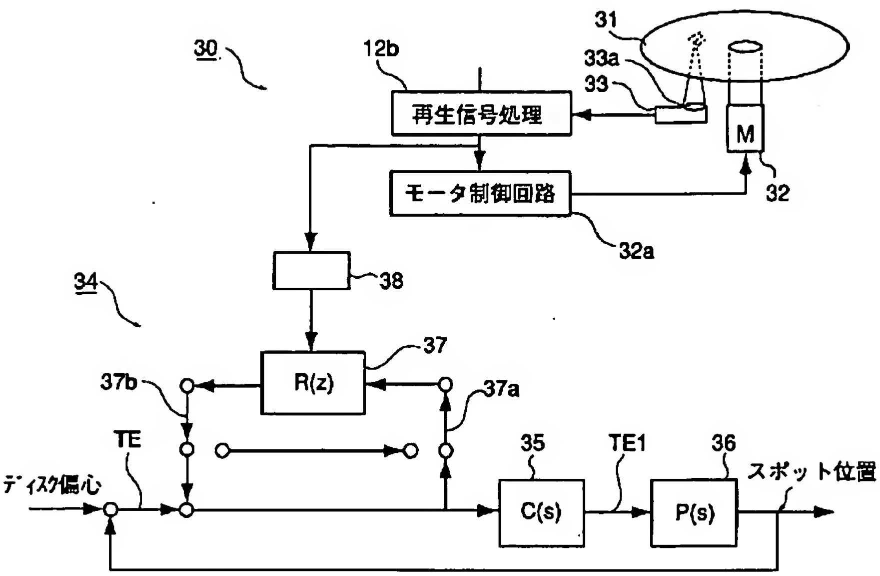
[Drawing 12]



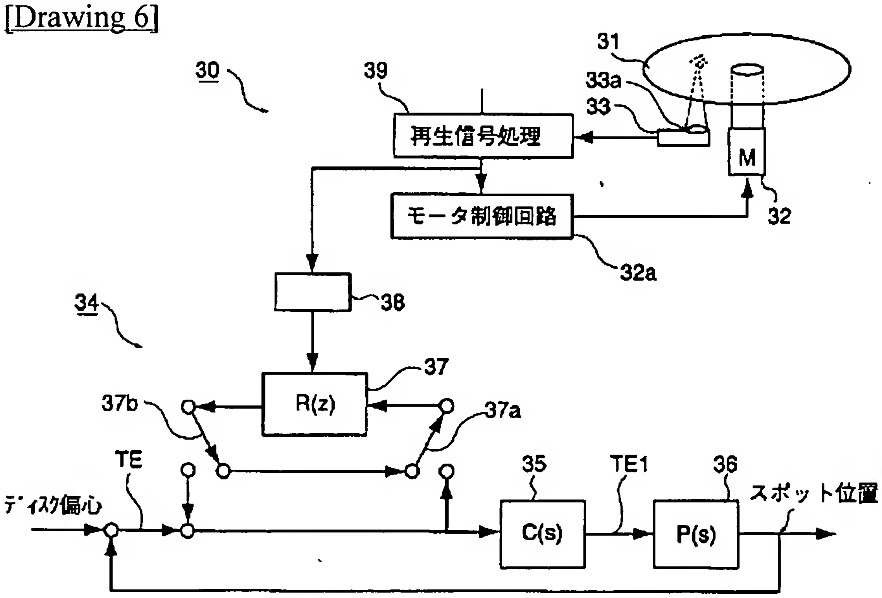
[Drawing 13]



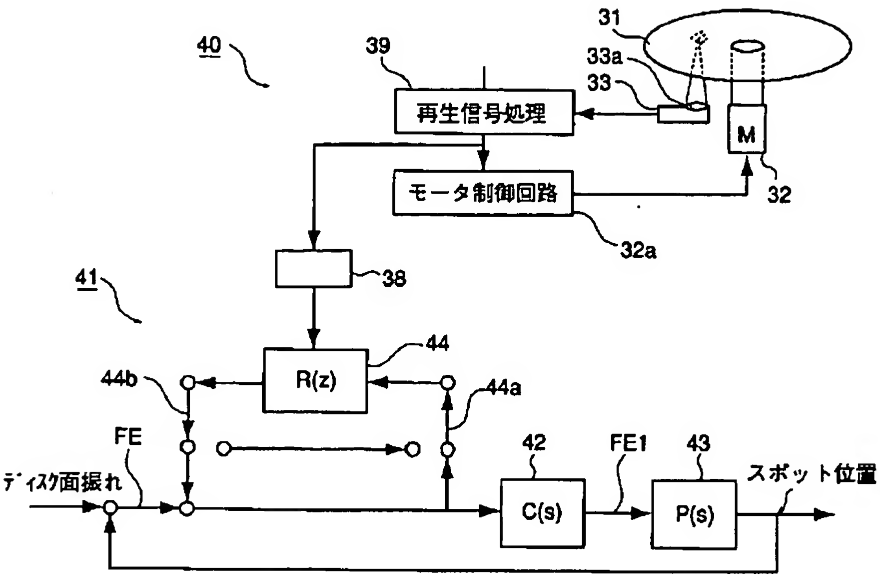
[Drawing 5]



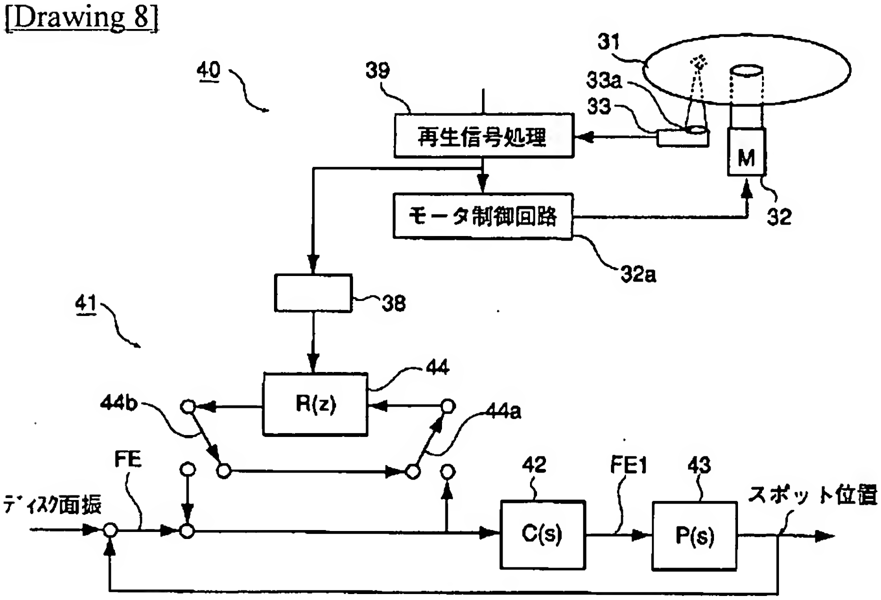
[Drawing 6]



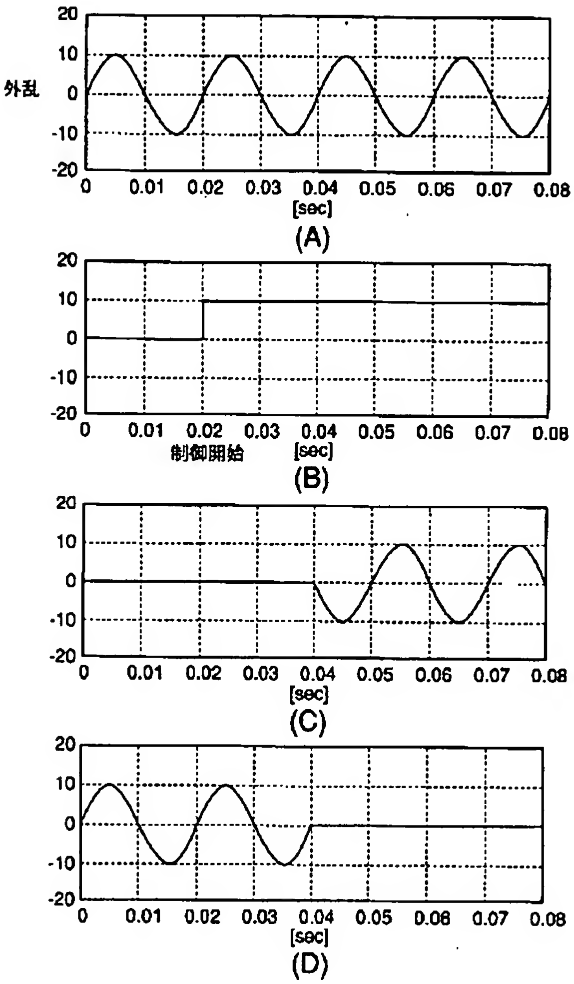
[Drawing 7]



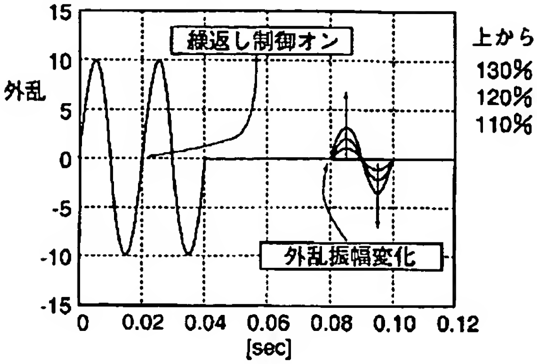
[Drawing 8]



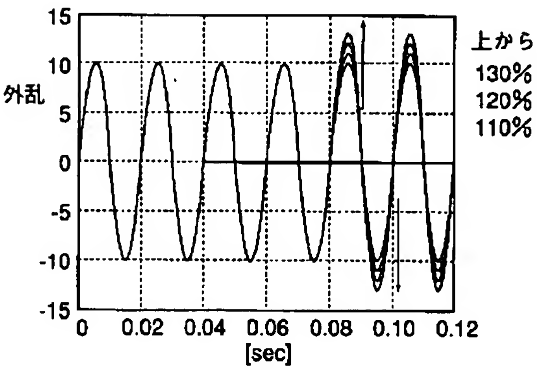
[Drawing 11]



[Drawing 14]

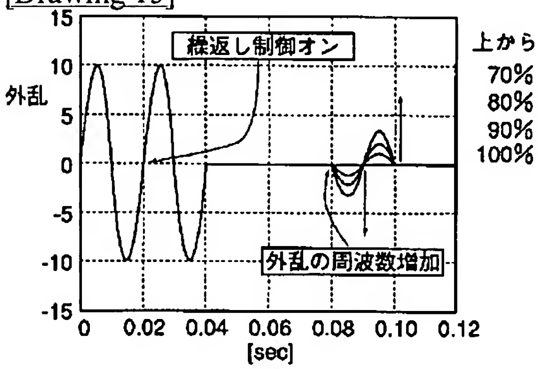


(A)

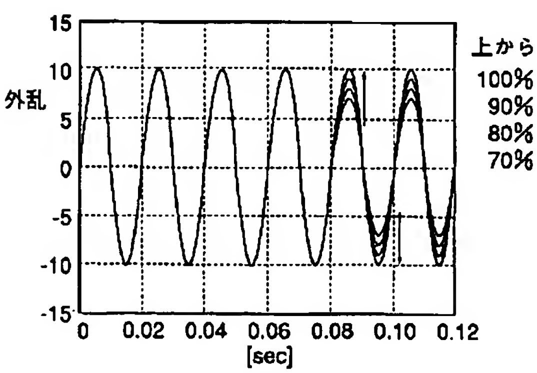


(B)

[Drawing 15]



(A)



(B)

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] To the signal recording surface of the optical disk by which a rotation drive is carried out, irradiate light from optical pickup and optical pickup detects the return light. The tracking actuator which is the control device of the optical disk unit which performs the record and/or playback of a signal to an optical disk, and carries out drive adjustment of the objective lens of said optical pickup about the direction of tracking of an optical disk, The control circuit which controls this tracking actuator based on the tracking error signal generated based on the detecting signal by said optical pickup, Learn the eccentricity of said optical disk and by the learning control based on this study data The optical disk control unit with which the learning-control means to which feedback is applied is included in said tracking error signal, and said learning-control means is characterized by performing learning control based on the study data learned beforehand at the time of control initiation.
[Claim 2] The optical disk control unit according to claim 1 with which said learning-control means is characterized by at least digital memory and a straight line consisting of either at least among phase digital filters.
[Claim 3] The optical disk control unit according to claim 1 with which said learning-control means holds study data, and is characterized by performing learning control after track jump termination based on the study data concerned in the case of a track jump.
[Claim 4] The optical disk control unit according to claim 1 with which said learning-control means is characterized by driving based on the clock signal generated by the signal generating circuit corresponding to rotation of an optical disk.
[Claim 5] The optical disk control unit according to claim 4 characterized by said signal generating circuit being the encoder formed in the rotation driving means of an optical disk.
[Claim 6] The optical disk control unit according to claim 4 characterized by for said optical disk being an optical disk which has the groove section by which wobbling was carried out with predetermined frequency, and generating a clock signal based on the wobbling signal with which said signal generating circuit was taken out from the detecting signal by optical pickup.
[Claim 7] The optical disk control unit according to claim 4 characterized by for said optical disk being an optical disk which has the land for recording a signal and/or the groove section, and the pit address part for recording address information, and generating a clock signal based on the address information by which said signal generating circuit was taken out from the detecting signal by optical pickup.
[Claim 8] The optical disk control unit according to claim 4 characterized by having the arithmetic circuit which the number of clocks per one revolution is changed, and inputs the clock signal from said signal generating circuit into a learning-control means corresponding to the rotational frequency of an optical disk.
[Claim 9] To the signal recording surface of the optical disk by which a rotation drive is carried out, irradiate light from optical pickup and optical pickup detects the return light. The focal actuator which is the control device of the optical disk unit which performs the record and/or playback of a signal to an optical disk, and carries out drive adjustment of the objective lens of said optical pickup about the

direction of a focus of an optical disk, The control circuit which controls this focal actuator based on the focal error signal generated based on the detecting signal by said optical pickup, Learn the face deflection of said optical disk and by the learning control based on this study data The optical disk control unit with which the learning-control means to which feedback is applied is included in said focal error signal, and said learning-control means is characterized by performing learning control based on the study data learned beforehand at the time of control initiation.

[Claim 10] The optical disk control unit according to claim 9 with which said learning-control means is characterized by at least digital memory and a straight line consisting of either at least among phase digital filters.

[Claim 11] The optical disk control unit according to claim 9 with which said learning-control means is characterized by holding study data and performing learning control after track jump termination based on the study data concerned in the case of a track jump.

[Claim 12] The optical disk control unit according to claim 9 with which said learning-control means is characterized by driving based on the clock signal generated by the signal generating circuit corresponding to rotation of an optical disk.

[Claim 13] The optical disk control unit according to claim 12 characterized by said signal generating circuit being the encoder formed in the rotation driving means of an optical disk.

[Claim 14] The optical disk control unit according to claim 12 characterized by for said optical disk being an optical disk which has the groove section by which wobbling was carried out with predetermined frequency, and generating a clock signal based on the wobbling signal with which said signal generating circuit was taken out from the detecting signal by optical pickup.

[Claim 15] The optical disk control unit according to claim 12 characterized by for said optical disk being an optical disk which has the land for recording a signal and/or the groove section, and the pit address part for recording address information, and generating a clock signal based on the address information by which said signal generating circuit was taken out from the detecting signal by optical pickup.

[Claim 16] The optical disk control unit according to claim 12 characterized by having the arithmetic circuit which the number of clocks per one revolution is changed, and inputs the clock signal from said signal generating circuit into a learning-control means corresponding to the rotational frequency of an optical disk.

[Claim 17] To the signal recording surface of the optical disk by which a rotation drive is carried out, irradiate light from optical pickup and optical pickup detects the return light. The actuator which is the optical disk unit which performs the record and/or playback of a signal to an optical disk, and carries out drive adjustment of the objective lens of said optical pickup about the direction of tracking and the direction of focusing of an optical disk, The control circuit which controls this actuator based on the tracking error signal and the focal error signal which were generated based on the detecting signal by said optical pickup, Learn the eccentricity and face deflection of said optical disk, and by the learning control based on this study data The optical disk unit with which the learning-control means to which feedback is applied is included in said tracking error signal and the focal error signal, and said learning-control means is characterized by performing learning control based on the study data learned beforehand at the time of control initiation.

[Translation done.]